

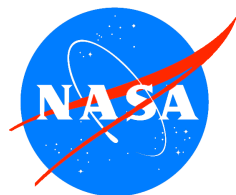
NASA SCIENCE MISSION DIRECTORATE

*Earth-Sun System Applied Sciences Program
Aviation Program Element
FY2006-2010 Plan*



Version: FINAL DRAFT

Date: 6/30/2006



*Expanding and accelerating the realization of economic and societal
benefits from Earth-Sun System science, information, and technology*

NASA Science Mission Directorate
Earth-Sun System Division
Applied Sciences Program

Applied Sciences for the Aviation Program Element:

This document contains the Aviation Program Element Plan for FY 2006-2010.

This plan derives from direction established in the NASA Strategic Plan, Earth Science Enterprise and Space Science Enterprise Strategies, Earth Science Applications Plan, and OMB/OSTP guidance on research and development. The plan aligns with and serves the commitments established in the NASA Integrated Budget and Performance Document.

The Program Manager and the Applied Sciences Program Leadership have reviewed the plan and agree that the plan appropriately reflects the goals, objectives, and activities for the Program Element to serve the Applied Sciences Program, Earth-Sun System Division, NASA, the Administration, and Society.

(Signature on file)

John A. Haynes
Program Manager, Aviation
Applied Sciences Program
NASA Earth-Sun System Division

Date

(Signature on file)

Lawrence Friedl
Lead, National Applications
Applied Sciences Program
NASA Earth-Sun System Division

Date

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Ronald J. Birk
Director, Applied Sciences Program
NASA Earth-Sun System Division

Date

NASA Earth-Sun System Division: Applied Sciences Program

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NASA Science Mission Directorate – Applied Sciences Program

Aviation Program Element Plan: FY 2006 - 2010

I. Purpose and Scope

This Applied Sciences National Applications Program Element Plan is applicable for Fiscal Years 2006 through 2010. The plan documents the purpose of the program and the implementation approach to meet the program objectives using the allocated resources. The plan describes the program element approach in extending NASA Earth-Sun system science research results to meet the decision support requirements of partner agencies and organizations. The Applied Sciences Program requires this plan to function as a program management tool, describing the program structure, functional mechanisms, performance measures, and general principles that will be followed in extending NASA research results for societal benefits.

Scope within NASA and Applied Sciences Program

Each National Applications Program Element is managed in accordance with, and is guided by, the NASA Strategic Plan and Earth Science Applications Plan. The program element benefits from NASA Earth-Sun system science research results and capabilities, including the fleet of NASA research satellites, the predictive capability of models in the Earth System Modeling Framework (ESMF), Project Columbia, the Joint Center for Satellite Data Assimilation (JCSDA), and the Earth-Sun System Gateway (ESG). The Applied Sciences Program seeks to develop with its partners scientifically credible integrated system solutions in which uncertainty characterization and risk mitigation has been performed using the capability of the national Earth-Sun laboratories and others in the community of practice.

The FY06 President's Budget for the NASA Applied Sciences Program specifies between \$48 million and \$55 million annually for FY06 – FY10. There are two elements to the Applied Sciences Program: National Applications and Crosscutting Solutions. Each National Applications Program Element benefits from the performance results of Crosscutting Solutions (see Crosscutting Solutions Program Element Plan). Each National Applications Program Element leverages and extends research results from the over \$2 billion per year supporting Earth-Sun system science and development of innovative aerospace science and technology. Additional information about the NASA Applied Sciences Program can be found at <http://science.hq.nasa.gov/earth-sun/applications>.

The Aviation Program Element is one of twelve Elements in the Science Mission Directorate's Applied Sciences Program. NASA and the Applied Sciences Program collaborate with partner organizations to enable and enhance the application of NASA's Earth-Sun system science research results to serve national priority policy and management decision support tools. The desired outcome is for partner organizations to use project results, such as prototypes and benchmark reports, to enable expanded use of Earth-Sun system science products and enhance decision support capabilities.

This Element focuses on the infusion of quality science observations from NASA Earth-Sun system spacecraft

missions and predictions from Earth-Sun system science models into Aviation Decision Support Systems (DSS) managed by partner agencies and organizations. As the input to these DSSs becomes more comprehensive and accurate, the decisions made using these systems increase in accuracy and utility. More accurate DSSs lead to improvements in the aviation industry with regard to safety, security, efficiency, and environmental impacts. Weather plays a major role in each of these areas. Weather is a contributing factor in approximately thirty percent of all aviation accidents. Weather forecast models are currently initialized by hourly observations taken at many ground stations, but precise observations of the atmosphere above the ground are sparse and infrequent. Accurate upper air data, from NASA research spacecraft with improved temporal and spatial coverage, is beneficial to aviation meteorologists. The purpose of the Aviation Program Element is to extend NASA Earth-Sun system spacecraft observations and Earth-Sun system science models to support the benchmarking of frequent, densely distributed Earth-Sun system science observations to support the National Airspace System (NAS) and address safety, capacity, security, and environmental issues. Observations from spacecraft such as TRMM, QuikSCAT, Terra, Aqua, and Aura support this purpose. Observations from future research missions such as NPP have the potential to add even greater value.

Impacts of weather upon aviation can be substantially mitigated using existing spacecraft weather information. At present, only a small percentage of the available spacecraft observations are used in operational weather forecasting. NASA and its partners are working to bridge the gap between research results and operational solutions that assimilate information obtained by Earth observation satellites. NASA and its partners are working to make sure that information available from instruments on current and future spacecraft research missions are verified and validated for infusion into operational forecasting techniques in a more timely fashion. To this end, the Aviation program element partners with the NASA Aeronautics Research Mission Directorate as well as several Federal organizations, including the Federal Aviation Administration (FAA), the Office of the Federal Coordinator for Meteorology (OFCM), and the National Oceanic and Atmospheric Administration (NOAA). To address aviation issues, the Science Mission Directorate partnership with the Aeronautics Research Mission Directorate currently includes the Aviation Safety Program (ASP) and will continue into from FY06 through FY10. More broadly, however, the Science Mission Directorate is coordinating with the recently established Joint Planning and Development Office (JPDO) consisting of the Departments of Transportation, Commerce, Defense, Homeland Security, NASA, and the Office of Science and Technology Policy (OSTP). The purpose of the JPDO is to transform the National Airspace System to improve its capacity and safety as required through the year 2025. The JPDO strategy was delivered to Congress as the "Next Generation Air Transportation System Integrated Plan" in December 2004. NASA's science activities are international in scope with participation by the European Space Agency, France, Canada, Japan, Russia, Brazil, The Netherlands, and Finland. NASA works collaboratively with national and international scientists, including the World Weather Research Program (WWRP) of the World Meteorological Organization (WMO) and with the National Resource Council of Canada through Meteorological Services Canada. NASA is also an active participant in the THORPEX international meteorological campaign coordinated through the WMO. Activities are also coordinated with members of the U.S. Weather Research Program (USWRP). A major thrust of the NASA Aviation Program Element is the Advanced Satellite Aviationweather Products (ASAP) activity (co-funded with NASA Aeronautics Research Mission Directorate). ASAP is a major component of AvSSP. This initiative began in 2002 and its objectives are:

- 1) to fill a critical gap in the integration of current Geostationary Operational Environmental Satellite (GOES) imagery and sounding observations in the production of operational aviation weather products (produced by the NOAA National Weather Service) that are developed by the FAA

Aviation Weather Research Program (AWRP);

- 2) to bridge the gap between developing aviation weather products using current Earth observation satellite imagery and sounding data and integrating next generation hyperspectral spacecraft observations of the atmosphere into aviation weather product development.

ASAP verifies and validates data obtained by the NPOESS Airborne Sounder Test-bed (NAST) and Scanning Hyperspectral Infrared Sounder (S-HIS) instruments, the Airborne Infrared Sounder (AIRS), the Cross-track Infrared Sounder (CrIS) as well as Polar and Geostationary Orbiting Environmental Satellites (POES and GOES), the Aqua Earth Observation spacecraft and the AURA atmospheric chemistry spacecraft. The goal of these ASAP efforts is to support FAA AWRP Product Development for ground and airborne product production and to conduct applications product demonstrations. ASAP plans primarily focus on In-flight Icing, Oceanic Weather, Turbulence, and Convection in FY06. In conjunction with the FAA AWRP's In-flight Icing PDT, ASAP plans to continue the integration of ASAP cloud microphysical properties and derived icing algorithms into the National Weather Service (NWS) Current Icing Potential product. Oceanic weather activities in FY06 focus on collaboration with the FAA AWRP's Oceanic Weather Product Development Team and the NASA AvSSP's Aviation Weather Information (AWIN) Project to develop prototype oceanic convective weather, turbulence, wind and volcanic ash products. The objective of this exercise is the validation of AWIN cockpit display systems using FAA AWRP graphical product prototypes that will eventually be provided operationally by the NWS Aviation Weather Center (AWC) in the same manner that they currently are provided by CONUS. This is a particular opportunity to accelerate the development of greatly needed oceanic weather hazard avoidance products that must be developed largely using spacecraft observations due to the remote nature of the operating areas and the lack of traditional surface-based observations such as radar and station reports. The further development and validation of these oceanic products is planned during the continued partnership with the NASA ASP. During FY05 the Program Element began to support the observation and decision support system requirements outlined in the National Aviation Weather Strategy developed by the interagency JPDO. This includes support for the development of an Aviation Weather Digital Database that underpins the National Airspace System. Earth-Sun system science research activities in FY06 will continue to focus on integrating current ASAP activities with FAA and NOAA efforts in support of the JPDO.

II. Goals and Objectives

Goals

The goal of the Applied Sciences Aviation Program Element is to enable beneficial use of Earth- Sun system science observations, models, and technologies to enhance decision support capabilities serving aviation management and policy responsibilities. The Integrated System Solution diagram (Appendix A) illustrates the extension of Earth science measurements, model products, and data fusion techniques to support NASA's partners' DSTs and the value and benefits of applied Earth-Sun science to society.

Objectives

All National Applications Program Elements are aligned to the NASA Strategic Plan and the agency's objectives as expressed in the NASA Integrated Budget and Performance Document (IBPD) and the Performance Assessment Rating Tool (PART).

NASA Strategic Plan Goal 2.1

September 2006 -- Benchmark reports on integration of ESMF predictions in FAA DSTs, specifically in the areas of oceanic turbulence, convective weather, and volcanic ash detection and tracking. (FY 06 IBPD metric)

September 2006 -- Evaluation report on the potential of NPP observations to serve the FAA National Airspace System. (FY 06 IBPD metric)

September 2006 -- Evaluation reports on all projects selected in the 2005 Decision solicitation.

September 2006 -- Operational CIP enhancement/transition to operations in conjunction with Project Columbia effort Year-long development:

- Space Weather Applications development with FAA and NOAA NCEP.
- Coordinate with the interagency JPDO and begin development of
- Aviation Weather Digital Database with FAA and NOAA/NCEP
- Transition ASAP research to the Weather Information System
- Enhancements (WISE) and Aviation Weather Digital Database (AWDD) projects of the reorganized
- Aeronautics Research Mission Directorate/ASP.

NASA Strategic Plan Goal 2.2

Aviation emissions project with Air Quality Program Element, if appropriate

FY07 and beyond:

NASA Strategic Plan Goal 2.2

Aviation emissions project with the Air Quality Program Element, if appropriate FY07-10

NASA Strategic Plan Goal 2.1

Development of Aviation Weather Digital Database and evaluation of WISE project.

V&V and Benchmark reports on all projects selected in the 2005 Decision solicitation by end of FY08.

III. Program Management and Partners

A. Program Management

Program Manager

Aviation Program Element

John A. Haynes

Applied Sciences Program , Science Mission Directorate

NASA Headquarters Responsibilities:

- Program Element development, strategy, plans, and budgets

- Program representation and advocacy of issues to Science Mission Directorate management and beyond
- Communication of Science Mission Directorate priorities and directives to Aviation application team/network
- Implementation of interagency agreements and partnerships
- Monitoring Aviation application metrics and performance evaluation
- Being cognizant of and meeting IBPD and PART responsibilities and requirements
- Oversight of HQ funded grants

Deputy Program Manager
Aviation Program Element
John J. Murray
Chemistry and Dynamics Branch, Science Directorate
NASA Langley Research Center

Responsibilities:

- Coordination between NASA Centers on Aviation Program Element activities
- Management of Aviation grants, contracts, and cooperative agreements funded by/through LaRC.
- Management of ASAP
- Co-chair, Observations Working Group, Interagency JPDO Aviation Weather IPT
- Leadership on project plans, development, performance, and partner relationships
- Communication of project metrics, performance, status, and issues to Program Manager
- Leadership and communications to Aviation application team and network

B. Aviation Network & Partners

Earth-Sun System Division and NASA Center Partners

NASA Aeronautics Research Mission Directorate:
Associate Administrator Dr. Lisa Porter
JPDO Principal Terrence Hertz
JPDO Aviation Weather IPT Representative Ron Colantonio
NASA Science Mission Directorate, Earth-Sun System Div.,
Flight Missions Program Director Charles Gay

NASA Science Mission Directorate, Business Management Division
Program Analyst Joan Haas

NASA Science Mission Directorate, Earth-Sun System Div.,
Research Program Weather Theme Lead Tsengdar Lee
Atmospheric Composition Theme Lead Phil DeCola
Earth Surface and Interior Lead John LeBrecque

NASA Ames Research Center (ARC)
Program Manager Steve Hipskind

NASA Marshall Space Flight Center (MSFC)
SPoRT Laboratory Director.....Steve Goodman

NASA Glenn Research Center (GRC)
Aerospace Engineer.....Mary Wadel

Federal Partners

FAA Aviation Weather Research Program: <http://www1.faa.gov/aua/awr>
AWRP Team LeaderGloria Kulesa
Office of the Federal Coordinator for Meteorology (OFCM): <http://www.ofcm.gov>
Senior Staff Physical Scientist.....Mary Cairns

FAA Operations
Member Manager.....Rick Heuwinkel (FAA ARW-100)
Specialist.....Steve Albersheim (FAA ARW-100)

NOAA/NWS Office of Science and Technology: <http://www.nws.noaa.gov/ost>
Coordinator of Aviation Weather Services.....Mark Andrews
Aviation Meteorologist.....Kevin Johnston

NOAA/NWS NCEP Aviation Weather Center (AWC): <http://aviationweather.gov>
Director.....Jack May
Science and Operations Officer.....Fred Mosher

FAA Technical Center
Aviation Weather Research Lead.....Danny Sims

NOAA National Environmental Satellite Data Information Service (NESDIS)
Senior Meteorologist.....Grace Swanson

NOAA/University of Wisconsin Cooperative Institute for Meteorological Satellite Studies (CIMSS)
Director.....Dr. Steven Ackerman
ASAP Manager.....Wayne Feltz

NOAA Forecast Systems Laboratory (FSL)
Branch Chief.....Dr. Stan Benjamin

Joint Planning and Development Office (JPDO): <http://www.jpdo.aero>
Chair: Norman Mineta, Secretary of U.S. Department of Transportation
Principals:
.....Mark Andrews, DoC
.....Terry Hertz, NASA
.....Jack Howell, FAA

.....Carl McCullough, DOD
.....Jon Montgomery, DoC
.....Marty Phillips, OSTP
.....Paul Polski, DHS

Regional Planning Organizations Partners: None.

International, National and Regional Organizations Partners:

National Center for Atmospheric Research (NCAR), Research Applications Program (RAP)
Manager of Engineering.....Bruce Carmichael
Project Scientist.....David Johnson

MIT Lincoln Laboratory (LL)
Co-chair, JPDO Observations Working Group.....Dr. Mark Weber

National Institute of Aerospace (NIA)
Lead.....Dr. Bill Grose
United States Weather Research Program (USWRP)
Lead Scientist.....Dr. Bob Gall

Aerospace States Association (ASA)
.....Lt. Gov. Mary Fallin (Oklahoma)

Western Governors Association (WGA)
.....Gov. Bill Richardson (New Mexico)

National States Geographic Information Council (NSGIC)
President.....William F. Johnson

GLOBE
Principal Investigator (Contrails).....Lin Chambers

International Partners and Points of Contact:

Radio Technical Commission for Aeronautics (RTCA)
Chairman.....Robert Blouin

International Civil Aviation Organization (ICAO)
Secretary General.....Taieb Cherif

National Research Council (NRC) Canada, Meteorological Service Canada (MSC), and the Canadian Weather
Research Program (CWRP)
Director (CWRP).....Dr. Jim Abraham
Senior Scientist.....Dr. George Isaac

DAACS and Earth Science Modeling Center Partners

The Aviation Program Element is also establishing working relationships with the NASA Distributed Active Archive Centers (DAACs) including the following:

- Goddard Earth Sciences DAAC (GSFC)
- Global Hydrology Resource Center (MSFC)
- Langley Atmospheric Sciences Data Center (LaRC)

The Aviation Program Element is also establishing working relationships with several Earth-Sun System science laboratories, including the following:

- Laboratory for Atmospheres (NASA/GSFC)
- Global Hydrology and Climate Center (NASA/MSFC)
- Short Term Prediction Research and Transition Center (NASA/MSFC)
- NOAA Office of Research and Applications
- NOAA National Centers for Environmental Prediction
- NASA/NOAA Joint Center for Satellite Data Assimilation
- National Center for Atmospheric Research

IV. Decision Support Tools and Management Issues

Priority Decision Support Tools

NAS

The National Airspace System (NAS) has many components and is a complex collection of systems, procedures, facilities, aircraft, and, of course, people. The mission of the NAS is to assure the safe and efficient movement of aircraft through the nation's airspace. The NAS, as directed by the FAA, represents the overall environment for the safe operation of aircraft. This environment includes the aircraft itself, the pilots, the facilities, the tower controllers, the terminal area controllers, the enroute controllers, and the oceanic controllers. This environment also includes the airports, the maintenance personnel and the airline dispatchers. All of this, including computers, communications equipment, spacecraft navigation aids, and radars, are a part of the NAS. Last year, within the NAS there were 640 million emplanements. This number could reach one billion within the next five to ten years. The Aviation Program Element focuses on four elements of the NAS: (1) FAA AWRP Nowcasting Products/AWC ADDS The Aviation Digital Data Service (ADDSD) makes available to the aviation community text, digital and graphical forecasts, analyses, and observations of aviation-related weather variables. ADDSD components are developed by the FAA AWRP and put into operational use by NOAA/NCEP/AWC. Components of ADDSD include the Current Icing Potential (CIP), Forecast Icing Potential (FIP), the National Convective Weather Forecast (NCWF), and the Graphical Turbulence Guidance (GTG). These products are crucial in decision-making on efficiency and safety issues for commercial and general aviation. Aviation Digital Data Service (ADDSD): <http://adds.aviationweather.noaa.gov/> Current Icing Potential (CIP): <http://aviationweather.gov/exp/cip/> Forecast Icing Potential (FIP): <http://sentinel.aviationweather.gov/icing/> National Convective Weather Forecast (NCWF): <http://adds.aviationweather.gov/convection/> Graphical Turbulence Guidance (GTG): <http://adds.aviationweather.gov/turbulence/> Oceanic Weather Product Development Team: http://www.rap.ucar.edu/projects/owpdt/realtime_systems.html (2) Numerical Aviation Weather Models The overall goal of the Weather Research and Forecast (WRF) Model project is to develop a next-generation mesoscale forecast model and assimilation system that will advance both the understanding and prediction of important mesoscale precipitation systems, and promote closer ties between the research and operational forecasting communities. The model is being developed as a collaborative effort among several government sponsored institutions (including the US Air Force, NOAA/FSL, and NOAA/NCEP), together with the participation of a number of university scientists. The WRF will provide improved mesoscale, short-term forecasts that will benefit both the commercial and general aviation community. Weather Research and Forecast Model (WRF): <http://wrf.fsl.noaa.gov/> The Rapid Update Cycle (RUC) is a NOAA operational weather prediction system comprised primarily of a numerical forecast model and an analysis system to initialize that model. The RUC was developed to serve users needing frequently updated shortrange weather forecasts, including those in the US aviation community. Rapid Update Cycle Model (RUC): <http://maps.fsl.noaa.gov/> (3) NOAA Volcanic Ash Advisory Center VAFTAD/HYSPLIT Model The Volcanic Ash Forecast Transport and Dispersion (VAFTAD)/HYSPLIT Model is a graphical forecast tool produced by NCEP which is used by the Volcanic Ash Advisory Center (VAAC) in Washington to construct Volcanic Ash Advisories (VAA). The VAFTAD/HYSPLIT model is supplemented by observations from Earth-Sun system science spacecraft, such as TOMS and the MODIS instruments onboard Aqua and Terra. Commercial airlines and the air traffic management community use VAAs to avoid risks posed by volcanic effluent. <http://www.ssd.noaa.gov/VAAC/vaftad.html> (4) National Airspace System Air Traffic Management Tools NASA/ARC develops Decision Support Tools for arrival, surface, and departure operations, and flight deck tools to support the FAA Free Flight Program. This Program also assures interoperability of tools internally and with the National Airspace System before transfer to the FAA for NAS implementation. <http://www.asc.nasa.gov/aatt/dst.html>

Potential Aviation Management Issues: FY06-FY10

The Program Element plans to support symposiums, workshops, and committees, and the newly formed Aviation Working Group in FY06 with \$50K, with funding staying level in FY07-10. The Program Element collaborates and is a member of the following organizations. Other divisions of NASA support these organizations.

- The Joint Planning and Development Office (JPDO) Aviation Weather IPT
 - o The JPDO Aviation Weather IPT is developing and implementing the National Aviation Weather Strategy.
 - o NASA Points of Contact: Co-chair, Observations Working Group, John Murray (LaRC), NASA Aeronautics Research Mission Directorate Coordination Manager, Ron Colantonio (GRC), Forecast Working Group, John Haynes (HQ)
- The Aircraft Icing Research Alliance
 - o NASA, the National Research Council of Canada, Transport Canada, and the Meteorological Service of Canada collaborate through this alliance on aircraft icing research to improve the safety of aircraft operations in icing conditions. The goal is to develop and implement an integrated icing research plan that balances short and long-term research needs. The alliance strengthens and fosters long term aircraft icing expertise, exchanges technical and scientific information, encourages the development of critical aircraft icing technologies, and provides a framework for collaboration between alliance members.
 - o NASA Point of Contact: Coordination Manager, Ron Colantonio (GRC)
- The Aviation Applications team participated in a conference between the Applied Sciences of NASA and the Office of Atmospheric and Climate Sciences of Environment Canada (EC). Representatives from both exchanged information about activities and research in Earth science fields and discussed the potential for mutually beneficial cooperative activities. Emphasis was placed on the importance of enhancing and expanding existing activities, including improvement upon environmental prediction tools. Aviation Weather Hazards was highlighted as a potential project. This collaboration will continue in FY06.
- The OFCM Volcanic Ash Working Group
 - o The OFCM is composed of several federal agencies including NASA, NOAA, FAA, USGS and DHS. The OFCM also includes academic partners such as MIT/LL. This office coordinates issues and programs dealing with meteorology and transportation throughout the federal government.
 - o NASA Point of Contact: John Haynes
- United States Weather Research Program (USWRP)
 - o The U.S. Weather Research Program coordinates research into more reliable and more focused forecasts to vulnerable regions and economic sectors. In a novel planning process, researchers, forecasters, and the users of forecast information identify the most relevant issues that have high potential for scientific progress. Through collaborative workshops, they lay out priorities, milestones, and resource needs and develop a fast track for scientific progress to transition into operational forecasting. Seven U.S. agencies currently support the USWRP: NOAA, the National Science Foundation (NSF), NASA, and the Departments of Defense (DOD), Transportation (DOT), Energy (DOE), and Agriculture (USDA).
 - o NASA Point of Contact: Weather Theme Lead, Tsengndar Lee (HQ)

The Aviation Program Element also plans a joint venture with the Air Quality application in FY06 to evaluate aircraft emissions DSTs, if funding is available. This evaluation, if deemed appropriate to continue as a project,

will proceed during FY 06-10. The program element continues to fully support a web site located at the following address: <http://www.science.hq.nasa.gov/earth-sun/applications/theme3.htm>.

Cross-Application Activities

The program consists of functional elements that contribute to all of the National Applications activities. The intention is to have the performance of these functions leverage accomplishments, and therefore the apparent resource investment, to the greatest extent possible into the National Applications partnerships. These functions are: Geoscience Standards and Interoperability, Human Capital Development, Integrated Benchmark Systems, and Solutions Networks. Examples of leveraged activities are:

- The Earth-Sun System Gateway is a "portal of portals" providing an access point through an Internet interface to all web-enabled NASA research results.
- A Solutions Networks capability to discover candidate configurations of NASA research results with the potential to improve partner's decision support systems.
- A Rapid Prototyping Capability to support NASA and partners in reducing uncertainty and testing the validity of NASA research results in decision support tools.
- Systems integration capability, knowledge tools and skilled human capital to help conduct studies on the systematic transitioning of the results of research to operational uses and the capability of operational systems to support scientific research.
- A student-based, human capital development program for building capability in entry level participants in the community of practice while developing solutions for state and local applications.

V. Application Activities

A. Projects

All National Applications Program Elements authorize peer-reviewed projects to support each element's goal and objectives. To secure funding and authorization to undertake activities supporting NASA and the Applied Sciences Program, project teams are responsible for developing project plans and managing the activities. The project plans specify the Earth-Sun observations, models, and other research results to extend to decision support tools as well as the activities to produce appropriate deliverables. The plans integrate contributions from appropriate the partners, NASA Centers and other contributors from the community of practice. Projects are expected to extend the benefits of NASA research results to the maximum extent possible, including the use observations from sensors on: Aura, Terra, Aqua, TRMM, NPP, NPOESS, Hydros, Topex, Jason, OCO and Aquarius.

B. Solicitations

The Applied Sciences Program utilizes full and open competitions to fund proposals from the community to contribute the Agency's objectives. This implementation strategy will continue to be critical part of extending the benefits of NASA Earth-Sun system research results and contributing to the improvement of future operational systems. The Program has participated in providing opportunities to the community in recent solicitations, including REASoN, Decisions 2004, and Decisions under ROSES. The proposals related to this National Applications Program Element that have been funded under these solicitations are described in Section V.D. Program Element Projects.

C. Congressionally Directed Activities

As of the publication of this document, an assignment of FY06 congressionally mandated activities was not completed by the Agency.

The procurement rules and management practices of the Agency require that congressionally mandated activities follow the same principles of planning and accountability as all other funded projects. Only activities that are aligned with NASA's mission, are technically credible, and are appropriately budgeted will be approved to receive funding from the Program. The project teams of congressionally mandated activities are responsible for developing project plans and managing the activities.

D. Program Element Projects

Included below are the brief descriptions of the funded projects managed under this National Applications Program Element. Complete and detailed descriptions are documented in the Project Plans for each activity.

Project: Alaska Aviation Safety Project					Congressionally Mandated	
Enhance General Aviation safety through the mountainous terrain of Alaska.				Budget (\$K)		
				Procurement		
				FY06	0	
Project Manager	Centers	Timeframe	Partners	FY07	0	
Tom Stanley	LaRC, SSC	FY05 - FY06	State of Alaska	FY08	0	
				FY09	0	
				FY10	0	
Earth Science Products				Other Apps.		
Deliverables	<u>Description</u>			<u>End Date</u> <u>IBPD Metric #</u>		
	Evaluation Report					
	Design & Implement					
	Verification and Validation Report					
	Benchmark Report					
Notes: Congressionally Directed funds of 2976K in FY05						

Project: Advanced Satellite Aviation-weather Products (ASAP)					Directed Project	
ASAP began in 2002 and its objectives are 1) to fill a critical gap in the integration of current Geostationary Operational Environmental Satellite GOES imagery and sounding data in the production of operational aviation weather products (produced by the National Weather Service) that are developed by the FAA Aviation Weather Research Program (AWRP) and 2) to bridge the gap between developing aviation weather products using current spacecraft imagery and sounding data to integrating the next generation of high-resolution, hyperspectral spacecraft observations into aviation weather product development.				Budget (\$K)		
				Procurement		
				FY06	1094	
Project Manager	Centers	Timeframe	Partners	FY07	485	
John Murray	LaRC (lead), GRC, ARC, MSFC	FY06 - FY10	FAA, NOAA	FY08	475	
				FY09	475	
				FY10	150	
Earth Science Products	GOES, POES, Terra (MODIS), Aqua (MODIS), TOMS, QuikSCAT (SeaWinds), TRMM			Other Apps.		
Deliverables	<u>Description</u>		<u>End Date</u>	<u>IBPD Metric #</u>		
	Evaluation Report		9/30/2006	6ASP03.B		
	Design & Implement		N/A			
	Verification and Validation Report		9/30/2006			
	Benchmark Report		9/30/2006	6ASP03.B		
	Project Plan		10/1/2005			
	Evaluation of Space Weather Tools		9/30/2006			
Notes:						

Project: NGATS Integrated Forecast and Observing System (IFOS)					Directed Project	
The NGATS/IFOS is slated to begin development in FY07. The NGATS/IFOS will combine Earth-Sun system observations and model predictions into a 5-D precise, continuously updating shortterm model of the atmosphere for aviation interests. The NGATS/IFOS is identified as the backbone for the JPDO/NGATS.				Budget (\$K)		
				Procurement		
				FY06	0	
Project Manager	Centers	Timeframe	Partners	FY07	215	
John Murray	LaRC (lead), GRC, ARC, MSFC	FY07 - FY10	FAA, NOAA	FY08	375	
				FY09	375	
				FY10	375	
Earth Science Products	GOES, POES, Terra (MODIS), Aqua (MODIS), Aura			Other Apps.		
Deliverables	<u>Description</u>		<u>End Date</u>	<u>IBPD Metric #</u>		
	Evaluation Report		9/30/2007			
	Design & Implement		N/A			
	Verification and Validation Report		9/30/2008			
	Benchmark Report		9/30/2010			
	Results Conference					
	Project Plan		10/1/2005			
Notes:						

Project: Program Management				Project Management	
Funds for sponsorship of workshops/symposiums/committees (including the Aviation Applications Working Group). In FY06, may also fund and NRC BASC study on a national mesoscale observation system.				<i>Budget (\$K)</i>	
				<i>Procurement</i>	
				FY06	50
<i>Project Manager</i>	<i>Centers</i>	<i>Timeframe</i>	<i>Partners</i>	FY07	50
John Haynes	All	FY06 - FY10		FY08	50
				FY09	50
				FY10	50
<i>Earth Science Products</i>				<i>Other Apps.</i>	
<i>Deliverables</i>	<u>Description</u>	<u>End Date</u>	<u>IBPD Metric #</u>		
	Evaluation Report				
	Design & Implement				
	Verification and Validation Report				
	Benchmark Report				
Project Plan	10/1/2005				
<i>Notes:</i>					

Project: Decision Support for Aircraft Avoidance of Convectively-Induced Turbulence Due to Thunderstorms					Solicitation	
The development of a decision support system (DSS) enhancement to the GTG for aircraft avoidance of convectively-induced turbulence (CIT) in and around thunderstorms is the focus of this project. CIT can occur in the clear air above thunderstorm cloud tops or laterally away from the perimeter of the cloud boundaries. CIT may be severe, leading to the injuries to passengers and crew; and the FAA provides pilot guidelines for thunderstorm avoidance for this very reason. However, these guidelines are based on an incomplete knowledge of the causes and phenomenological nature of CIT, and therefore may lead to situations where the guidelines are in fact misleading and inadequate.				Budget (\$K)		
				Procurement		
				FY06	366	
Project Manager	Centers	Timeframe	Partners	FY07	366	
John Murray	LaRC	FY05 - FY07	NCAR, UW, UAH	FY08	0	
				FY09	0	
				FY10	0	
Earth Science Products	MODIS, LMA, VALIDAR, NOAA GOES			Other Apps.		
Deliverables	<u>Description</u>		<u>End Date</u>	<u>IBPD Metric #</u>		
	Evaluation Report		9/30/2006			
	Design & Implement					
	Verification and Validation Report		9/30/2007			
	Benchmark Report		9/30/2008			
Notes:						

Project: Near Real-time NASA Volcanic Cloud Data for NOAA, FAA, and USGS Decision Support Systems					Solicitation	
Volcanic eruptions can deposit large clouds of ash and SO2 at typical cruise altitudes, posing a substantial risk to aircraft and passengers. Current operational satellites cannot meet the aviation requirements for timely location of volcanic clouds. Aura/OMI and Aqua/AIRS will provide supplementary observations through this project that will reduce false alarms and improve cloud detection reliability. Primary teaming DSSs are the VAACs in Washington and Anchorage, the NOAA/FSL Volcanic Ash Coordination Tool (VACT), and the FAA's OWPDT.				Budget (\$K)		
				Procurement		
				FY06	400	
Project Manager	Centers	Timeframe	Partners	FY07	400	
John Murray	GSFC	FY05 - FY07	UMBC, USGS, NOAA, UCAR, KNMI	FY08	0	
				FY09	0	
				FY10	0	
Earth Science Products	Aura/OMI, Aqua/AIRS			Other Apps.		
Deliverables	<u>Description</u>		<u>End Date</u>	<u>IBPD Metric #</u>		
	Evaluation Report		9/30/2006			
	Design & Implement					
	Verification and Validation Report		9/30/2007			
	Benchmark Report		9/30/2008			
Notes:						

Project: Improvement of Operational Aircraft Icing Forecasts and Diagnoses by Assimilation of Satellite Cloud/Surface Properties in the RUC/WRF					Solicitation	
Liquid Water Path (LWP) is one of the key variables for diagnosing aircraft icing conditions and is currently represented poorly in the NWP models. In particular, is the NOAA Rapid Update Cycle (RUC) model used by the FAA Aviation Weather Program for diagnosing and forecasting aircraft icing conditions. NASA Earth science products derived from NOAA GOES, as well as observatioins from MODIS, include state of the art LWP estimates that are made available in a timely fashion. This project will assimilate the NASA/LaRC GOES and MODIS cloud products into the RUC analysis to improve diagnoses and forecasts of aircraft icing conditions.				Budget (\$K)		
				Procurement		
				FY06	392	
Project Manager	Centers	Timeframe	Partners	FY07	392	
John Murray	LaRC	FY05 - FY07	NOAA	FY08	0	
				FY09	0	
				FY10	0	
Earth Science Products	MODIS, NOAA GOES			Other Apps.		
Deliverables	<u>Description</u>		<u>End Date</u>	<u>IBPD Metric #</u>		
	Evaluation Report		9/30/2006			
	Design & Implement					
	Verification and Validation Report		9/30/2007			
	Benchmark Report		9/30/2008			
Notes:						

Project: Oceanic Convective Weather Diagnosis and Nowcasting					Solicitation	
For the purpose of enhancing aviation safety, the Oceanic Weather PDT will create, test, validate and demonstrate satellite-based oceanic convective products in near real-time to the aviation community. The satellite sensor data will focus on NASA research and development (R&D) sensors that measure meteorological variables and features closely associated with hazardous convective clouds, a frequent source of heavy rain, lightning, turbulence and aircraft icing.				Budget (\$K)		
				Procurement		
				FY06	0	
Project Manager	Centers	Timeframe	Partners	FY07	0	
John Murray		FY05 - FY06	NRL, NCAR	FY08	0	
				FY09	0	
				FY10	0	
Earth Science Products	Advanced Microwave Scanning Radiometer - AMSR-E Advanced Microwave Sounding Unit - AMSU on Aqua spacecraft QuikScat SeaWinds scatterometer			Other Apps.		
Deliverables	<u>Description</u>			<u>End Date</u>	<u>IBPD Metric #</u>	
	Evaluation Report			9/30/2006		
	Design & Implement					
	Verification and Validation Report					
	Benchmark Report					
Notes: This Project received 200K in FY05 funds.						

E. Additional Activities & Linkages

NASA and Science Mission Directorate Priorities The Air Quality Management Program leverages, utilizes, and contributes to priority activities of NASA and the Federal Government, including:

- Federal Enterprise Architecture (FEA) is a business and performance-based framework to support cross-agency collaboration, transformation, and government-wide improvement. NASA Air Quality Program Element FY 2005-2009 Plan 3/15/2005 17 aq_ver1-1.doc
- The Global Information Grid (GIG) is the first stage of a U.S. military global, highbandwidth, internet protocol-based communications network (a.k.a., 'internet in space').
- The Joint Center for Satellite Data Assimilation (JCSDA) is a multi-agency collaboration to accelerate and improve the quantitative use of research and operational observational spacecraft data in weather and climate prediction models. NOAA (NESDIS, NWS, OAR), NASA, Navy, Air Force, and NSF (through UCAR) collaborate in JCSDA.
- Metis is a visual modeling software tool for planning, developing, and analyzing agencies' enterprise architectures. The Applied Sciences Program is using Metis to identify possible linkages between observations, models, and decision support tools to support the IWGEO and NASA/NOAA R2O activities.
- Observing System Simulation Experiments (OSSEs) use simulated observations to assess the impacts of future observational spacecraft instruments on weather and climate prediction, and OSSEs provide opportunities to test new designs and methodologies for data-gathering and assimilation.
- Project Columbia is a NASA-wide project to develop a new, fast supercomputer (using an integrated cluster of interconnected processor systems) to support the Agency's mission and science goals, including enhanced predictions of weather, climate, and natural hazards.

Science Mission Directorate Fellows:

1. Sonia Kreidenweis, "Laboratory Investigations of the Links Between Mineral Dust and Cloud Formation", Colorado State University
2. Bernard Engel, "Terrain Analysis and Surface Hydrologic Modeling Strategies Using High-Resolution Global Digital Topography", Purdue University

E. IBS Request

- A Rapid Prototyping Center is a proposed center at Stennis to support NASA and partners in testing and verification of Earth science results in decision support tools.
- Transition from Research to Operations Network (R2O) is a network that focuses on systematically transitioning the results of research to operational uses.

Program Response to IBS Request

To be supplied by program management.

E. Crosscutting Request

DEVELOP is a student-based program for rapidly prototyping solutions for state and local applications and helping students develop capabilities related to applied Earth-Sun science.

The Earth-Sun System Gateway is a "portal of portals" providing an access point through an Internet interface to all web-enabled NASA research results.

Program Response to Crosscutting Request

To be supplied by program management.

VI. Budget: FY06-010

The following table lists the Aviation Program budget (procurement) for FY2006:

<u>Project</u>	FY06 Procurement Allocation (\$K)
Advanced Satellite Aviation-weather Products (ASAP)	\$ 1094
Aviation Weather Digital Database (AWDD)	\$ 0
Weather Information System Enhancements (WISE)	\$ 0
Decision Support for Aircraft Avoidance of Convectively-Induced Turbulence Due to Thunderstorms	\$ 366
Near Real-time NASA Volcanic Cloud Data for NOAA, FAA, and USGS Decision Support Systems	\$ 400
Improvement of Operational Aircraft Icing Forecasts and Diagnoses by Assimilation of Satellite Cloud/Surface Properties in the RUC/WRF	\$ 392
Oceanic Convective Weather Diagnosis and Nowcasting	\$ 0
Alaska Aviation Safety Project	\$ 0
Program Management	\$ 50
Total = \$ 2302	

Appendix C lists program-wide budget allocations for FY2006-10.

VII. Program Management and Performance Measures

The Aviation Management Team uses performance measures to track progress, identify issues, evaluate projects, make adjustments, and establish results of the Program Element. The Aviation Program Element's Goals and Objectives (Section II) state what the Program Element intends to achieve. These measures help monitor progress within and across specific activities to ensure the Program meets its goals and objectives.¹ The management team analyzes these measures retrospectively in order to make adjustments proscriptively to the program approach and objectives.

The measures are in two categories: Program Management measures are internally focused to assess the activities within the program. Performance measures are externally focused to assess whether the Program activities are serving their intended purpose. In general, the Aviation Program Element uses these measures to evaluate the performance of activities conducted and sponsored by the program, especially the projects. In addition, the Applied Sciences Program uses this information in preparing IBPD directions and PART responses.

Program Management Measures (Internal):

Inputs:

- 1) Potential issues and DSTs identified for Aviation – number, type, range
- 2) Eligible partners to collaborate with – number, type, range
- 3) Potential results/products identified to serve Aviation – number, type, range

Outputs:

- 1) Assessments or evaluations of DSTs – number, range
- 2) Assessments of Earth-Sun science results/products to serve DSTs – number, range
- 3) Agreements with partners – presence
- 4) Reports (evaluation, validation, benchmark) – number, type

Quality and Efficiency:

- 1) Earth-Sun science results/products – number used per DST, ratio of utilized to potential
- 2) Agreements – ratio of agreements to committed partners
- 3) Reports – partner satisfaction, timeliness, time to develop

Performance and Results Measures (External):

Outcomes:

- 1) Earth-Sun science products adopted in DSTs – number, type, range; use in DST over time
- 2) Earth-Sun science products in use – ratio of products used by partners to reports produced
- 3) Partner and DST performance – change in partner DST performance, number & type of public recognition of use & value of Earth-Sun science data in DST

Impacts:

- 1) Partner value – change in partner metrics (improvements in value of partner decisions)

In addition to the stated measures, Aviation Program Management periodically requests an assessment of its plans,

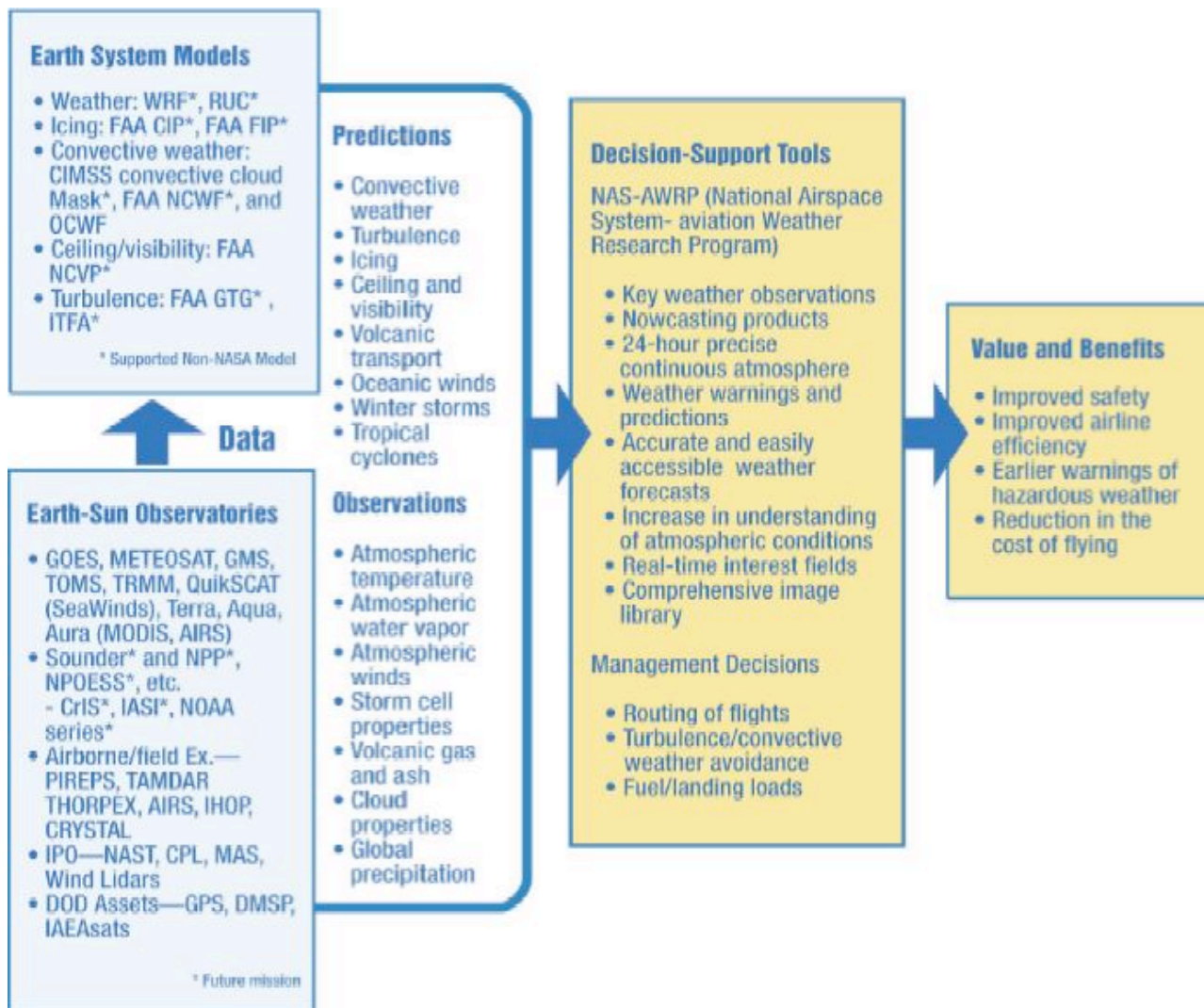
goals, priorities, and activities through external review. The Aviation Team uses these measures along with comparisons to programmatic benchmarks to support assessments of the Applied Sciences Program (e.g. internal NASA reviews and OMB PART). Specifically, the Aviation Program Element uses comparisons to similar activities in the following programs (i.e., program benchmarks) to evaluate its progress and achievements:

- Environmental and Societal Impacts Group at NCAR
- Global Monitoring for Environment and Security (GMES)

VIII. Appendices

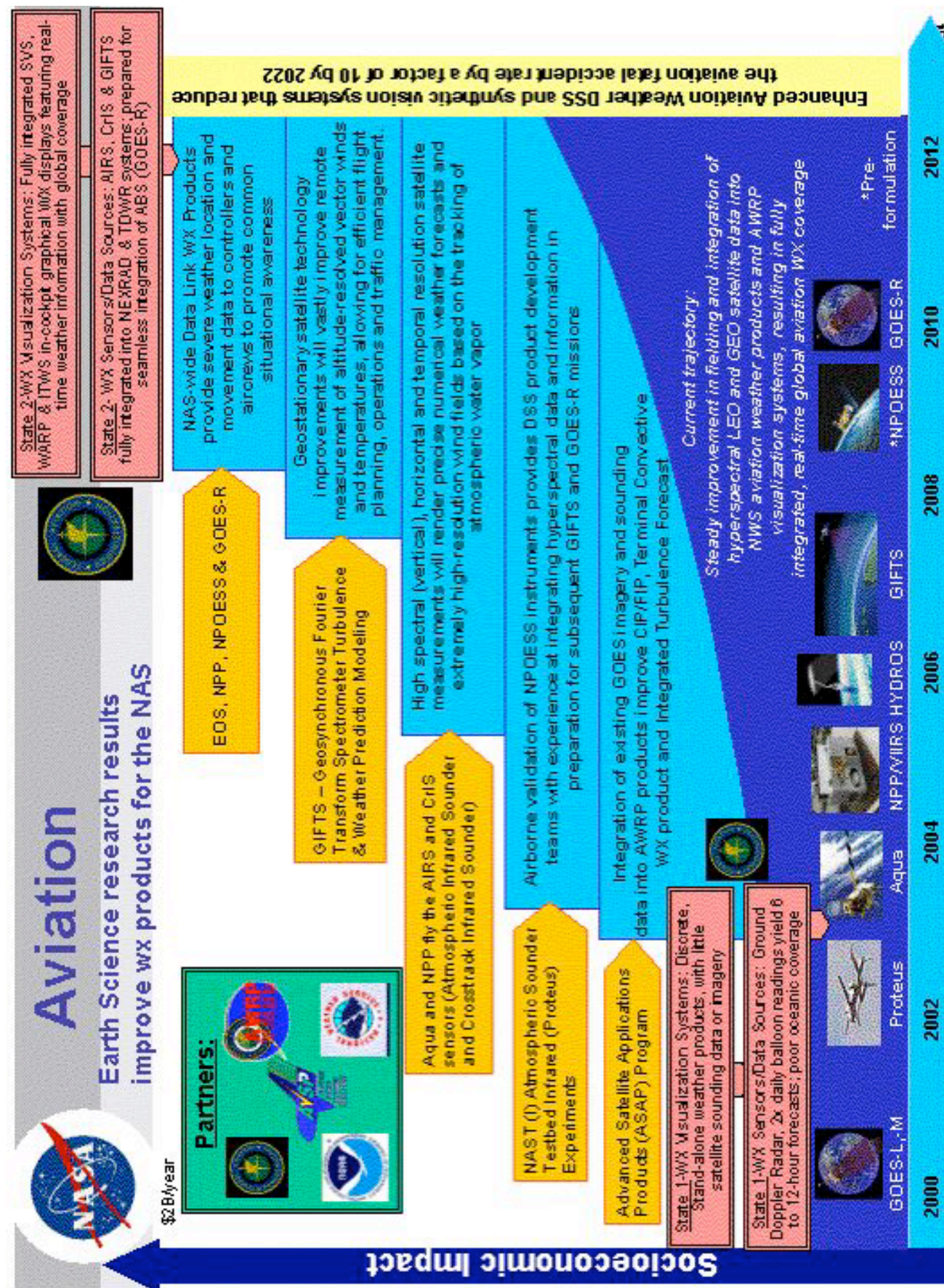
A. Integrated System Solutions Diagram

The figure below illustrates how Science measurements, model products, and data fusion techniques support the Aviation Program's partners and their decision support tools and shows the value and benefits of Science to society.



B. Roadmap

The following roadmap shows the direction of the program over the next ten years. It illustrates the current state of Aviation DSTs and the projected state of those DSTs with the infusion of NASA Earth-Sun system science research results. The Aviation program plan deals in detail with the first five years of the roadmap.



C. Applied Sciences Program Budgets FY2006-10

The following figures represent the FY06 budgets for the respective Program Elements; they do not represent the entire Applied Sciences Program budget. There is an additional \$8.95million in Congressionally-directed activities and \$5million for the Mississippi Research Consortium that these figures do not incorporate.

Program Element	FY06 Procurement Allocation
National Applications	
Agricultural Efficiency	\$ 1,955,803
Air Quality	\$ 3,116,464
Aviation	\$ 3,048,878
Carbon Management	\$ 1,544,831
Coastal Management	\$ 1,416,233
Disaster Management	\$ 2,743,760
Ecological Forecasting	\$ 3,240,170
Energy Management	\$ 1,875,253
Homeland Security	\$ 1,987,054
Invasive Species	\$ 2,241,940
Public Health	\$ 3,356,124
Water Management	\$ 1,714,341
Crosscutting Solutions	
DEVELOP	\$ 1,498,000
Geospatial Interoperability	\$ 2,400,000
Solutions Networks	\$ 2,822,000
Integrated Benchmarking System	\$ 4,500,000

The following figures show the five-year run-out for the entire Applied Sciences Program. The figures are based on the FY07 President's budget submitted to Congress. The lower line shows the target budget including agency corporate and institutional adjustments.

	2006	2007	2008	2009	2010
Present Budget Summited to Congress	53,254,855	51,049,000	50,287,000	48,588,000	48,662,000
Target After Adjustments	47,321,663	39,101,000	33,922,000	34,801,000	34,803,000

D. Related NASA and Partner Solicitations and Grants

Appendix D lists NASA Earth-Sun system science research projects, Earth science fellowships, GLOBE activities, and Earth science New Investigators related to Aviation activities.

<u>Institution</u>	<u>PI</u>	<u>Title/Subject</u>	<u>Timeframe</u>
None Listed		None Listed	

E. Acronyms and Websites

ACRONYMS:

ADDS	Automated Digital Data Server
ADDS	Aviation Digital Data Service
AIRS	Alliance Icing Research Study
ARC	Ames Research Center
ASA	Aerospace States Association
ASAP	Advanced Satellite Aviation-weather Products
ATM	Air Traffic Management
AVHRR	Advanced Very High Resolution Radiometer
AvSSP	Aviation Safety and Security Program
AWC	Aviation Weather Center
AWDD	Aviation Weather Digital Database
AWIN	Aviation Weather Information
AWIPS	Advanced Weather Interactive Processing System
AWRP	Aviation Weather Research Program
AWTT	Aviation Weather Technology Transfer
CCSP	Climate Change Science Program
CCTP	Climate Change Technology Program
CIMSS	Cooperative Institute for Meteorological Satellite Studies
CIP	Current Icing Product
CNS	Canadian Nuclear Society
CONUS	Coverage of Continental United States
COTR	Contracting Officer's Technical Representative
CrIS	Cross-track Infrared Sounder
CWRP	Canadian Weather Research Program
DAAC	Distributed Active Archive Center (Data Active Archive Center)
DHS	Department of Homeland Security
DOC	US Department of Commerce
DOD	US Department of Defense
DOE	US Department of Energy
DOT	US Department of Transportation
DSS	Decision Support Systems
DST	Decision Support Tool
ESA	Earth Science Applications
FAA	Federal Aviation Administration
FEA	Federal Enterprise Architecture
FIP	Forecast Icing Potential
FSL	Forecast Systems Laboratory
FY	Fiscal Year
GIFTS	Geosynchronous Imaging Fourier Transform Spectrometer
GIG	Global Information Grid
GIS	Geographic Information System

GLOBE	Global Learning and Observations to Benefit the Environment
GMS	Ground Water Modeling System
GOES	Geostationary Operational Environmental Satellite
GRC	Glenn Research Center
GTG	Graphical Turbulence Guidance
IBPD	Integrated Budget and Performance Document
ICAO	International Civil Aviation Organization
IPT	Integrated Product Team
IWGEO	Interagency Working Group on Earth Observations
JCSDA	Joint Center for Satellite Data Assimilation
JPDO	Joint Planning and Development Office
LaRC	Langley Research Center
LL	Lincoln Laboratory
METEOSAT	European Meteorological Satellite
MIT	Massachusetts Institute of Technology
MODIS	Moderate Resolution Imaging Spectroradiometer
MSC	Meteorological Service Canada
MSFC	Marshall Space Flight Center
NAS	National Airspace System
NASA HQ	NASA Headquarters
NASA	National Aeronautics and Space Administration
NAST	NPOESS Airborne Sounder Test-bed
NCAR	National Center for Atmospheric Research
NCEP	National Centers for Environmental Prediction
NCWF	National Convective Weather Forecast
NESDIS	National Environmental Satellite Data Information Service
NIA	National Institute of Aerospace
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-Orbiting Operational Environmental Satellite System
NPP	NPOESS Preparatory Project/Net Primary Productivity
NRC	National Research Council
NSF	National Science Foundation
NSGIC	National States Geographic Information Council
NWS	National Weather Service
OAR	Office of Oceanic and Atmospheric Research
OFCM	Office of the Federal Coordinator for Meteorology
OMB	Office of Management and Budget
OS&T	Office of Science and Technology
OSSE	Observing System Simulation Experiment
OSTP	Office of Science and Technology Policy
PART	Program Assessment Rating Tool
PDT	Product Development Team
POC	Point of Contact
POES	Polar Orbiting Environmental Satellites
QuikSCAT	Quick Scatterometer

R2O	Research to Operations Network
RAP	Research Applications Program
RTCA	Radio Technical Commission for Aeronautics
RUC	Rapid Update Cycle
SEA	State Enterprise Architecture
S-HIS	Scanning Hyperspectral Infrared Sounder
SSC	Stennis Space Center
TERRA	Not an Acronym
THORPEX	The Observing-System Research and Predictability Experiment
TOMS	Total Ozone Mapping Spectrometer
TRMM	Tropical Rainfall Measurement Mission
UCAR	University Corporation for Atmospheric Research
USDA	US Department of Agriculture
USGS	United States Geological Survey
USWRP	United States Weather Research Program
UW	University of Wisconsin
VAA	Volcanic Ash Advisories
VAAC	Volcanic Ash Advisory Center
VAFTAD	Volcanic Ash Forecast Transport and Dispersion
WGA	Western Governors' Association
WINGS	Weather Information Next-Generation Sensors
WISE	Weather Information System Enhancements
WMO	World Meteorological Organization
WRF	Weather Research and Forecast
WWRP	World Weather Research Program

WEBSITES:

AIWG: <http://aiwg.gsfc.nasa.gov>

Applied Sciences Program: <http://science.hq.nasa.gov/earth-sun/applications>

DEVELOP: <http://develop.larc.nasa.gov>

Earth-Sun System Gateway (ESG): <http://esg.gsfc.nasa.gov/>

Earth-Sun Science System Components: <http://www.asd.ssc.nasa.gov/m2m>

NASA FY2005 Budget: <http://www.ifmp.nasa.gov/codeb/budget2005>

Research and Analysis Program: <http://science.hq.nasa.gov/earth-sun/science/>

Science Mission Directorate: <http://science.hq.nasa.gov>

Science Strategies: <http://science.hq.nasa.gov/strategy/>